Rocky Mountain National Park
FARSITE Development Narrative
July, 2006

File Name: ***ROMO_2006_40FM.LCP*** (FARSITE Landscape File)

Purpose: This FARSITE landscape file can be used by the fire behavior modeling and simulation programs FARSITE and FlamMap. The landscape was developed using the standard process for creating FARSITE landscapes (as outlined in the FARSITE Help Menu) from the fuels coverage described below.

- Projection and Datum: UTM Zone 13, Meters, NAD 1983
- Date Completed: July 10, 2006
- Contact: Pat Stephen, Fuels - Fire Behavior Technical Specialist, NPS - IMRO

Development process:

The ROMOVEG coverage ROMOVEGmetadata.html developed by the NPS Inventory and Monitoring Program for Rocky Mountain National Park (RMNP) was used to derive the fuel characteristics as described below and to create the fuels grid (ROMO_fuels) from which the FARSITE landscape (LCP) was developed. The LCP file was then modified (using FARSITE's Landscape Calculator) to reflect changes in the fuels due to mechanical treatments since 2001. The resulting FARSITE landscape covers all of RMNP as well as the surrounding environs.

FUELS :

A Vegetation-to-Fuels crosswalk workshop was conducted on March 2, 2006 with participants from Rocky Mountain National Park fire and resource management staffs as well as numerous other interested individuals: Nathan Williamson (ROMO fire ecologist), Doug Watry (ROMO Fuels Management Specialist), Emily Gubler (ROMO Fuels Technician), Michelle Anderson (ROMO FPMA), Justin Kincaid (Alpine IHC Logistics Foreman), Ron Thomas (ROMO GIS Specialist), David Pillmore (Database Technician, I & M Rocky Mountain Network), Jeff Connor (ROMO Natural Resource Specialist), Kara Paintner (Fire Ecologist & Natural Resource Liason, NIFC), Karl Brown (I & M Vegetation Mapping Program Manager) Mohammed Kalkhan (professor, Colorado State University) Chris Lea (botanist, I & M Vegetation Mapping Program), Paul Mintier (ARNF – Sulphur Ranger District FMO), Dave Farmer (Colorado State Forester), Jesse Duhnkrack (former ROMO Fire Management Officer and current IMRO fire planner). Intermountain Regional fire staff members (Doug Stephen and Pat Stephen) facilitated the discussion.

During the workshop, vegetation types (Common_Map name) were discussed and the group came to a consensus on the assignment of the most appropriate FBPS (Anderson 1-13 (see anderson_aids_fm_int_gtr122.pdf) and Scott and Burgan 40 (see ScottBurgan2005-GTR-153.pdf)) fuel models based on vegetation type, canopy cover, side of Continental Divide (east versus west) and location in the park.

In addition, the group discussed the assignment of Canopy Base Height (CBH) values for vegetation types that had an overstory canopy that could torch and cause spot fires. The local subject matter experts gave guidance as to the environmental conditions in which passive

crownfire occurs. These conditions were then used as inputs into Joe Scott's CBH calculation spreadsheet (CBH_calc_v2.xls) for determining the appropriate CBH values (see figure 1).

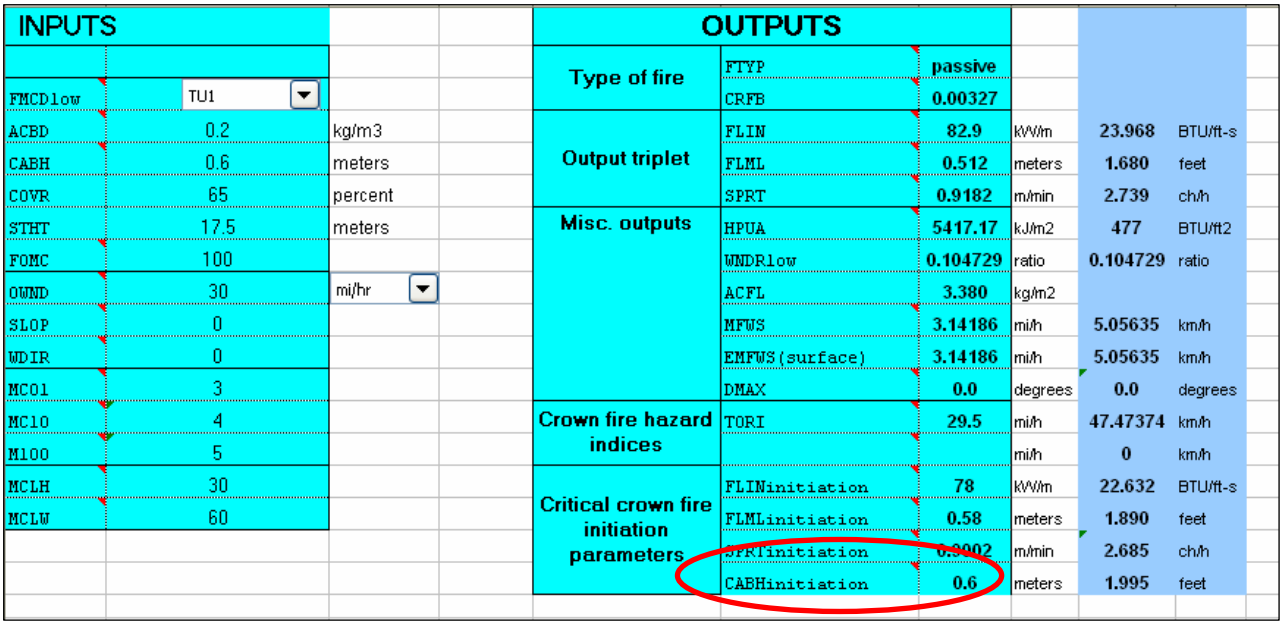


Figure 1. Example of using CBH_calc for determining appropriate Canopy Base Height.

The group was unable to finish the fuel assignment crosswalk in one day so it was agreed that the remaining vegetation types should have fuel values assigned by Pat Stephen using vegetation/fuels plot data and photos as well as her local knowledge of the park. A draft fuels map was created and presented to Rocky Mountain National Park fire staff on June 29, 2006 and the requested revisions (Elk Winter Range fuels modified as shown in table below) were made using *elkranges05_NAD83.shp*. Fuel model numbers and canopy characteristic values assigned can be found in Table 1.

Table 1. Fuels Characteristics assigned during vegetation-to-fuels crosswalk (sorted largest to smallest acreage)

Vegetation / cover type	Fuel Model 13	Fuel Model 40	Calculated cbh_meters	Conditions for transition to crownfire
SubAlpine Mixed Conifer	8	161	0.61	3% FDFM, low live FM 3 mph eyelevel winds
Montane Douglas Fir	10	165	2.93	6% FDFM, low live FM 3 mph eyelevel winds
Lodgepole Pine - Low Elevation < 9500 ft West side of Continental Divide	8	161	1.22	2% FDFM, low live FM 7 mph eyelevel winds
Lodgepole Pine - Low Elevation < 9500 ft East side of Continental Divide	8	183	0.61	2% FDFM, 7 mph eyelevel winds
Herbaceous Wetland SubAlpine/Alpine- Meadow	8	181	0	Not Applicable
Herbaceous Upland Alpine Fellfield	99	99	0	Not Applicable
Talus and Outwash	99	99	0	Not Applicable
Cliff Face - Bare Soil / Rock, exposed soil	99	99	0	Not Applicable
Herbaceous Upland Alpine > 9600 ft	99	181	0	Not Applicable
Lodgepole Pine - High Elevation > 9500 ft West side of Continental Divide	8	161	1.22	2% FDFM, low live FM 7 mph eyelevel winds
Ponderosa Pine Shrubland	2	122	3.48	6% FDFM, low live FM 5 mph eyelevel winds
Lodgepole Pine - High Elevation > 9500 ft East side of Continental Divide	8	184	0.76	2% FDFM, 7 mph eyelevel winds
Ponderosa Pine Rockland	9	183	0.37	5% FDFM, 7 mph eyelevel winds
Herbaceous Upland Montane < 9600 ft	1	101	0	Not Applicable
Riparian Upper Montane Mixed Conifer > 8500 ft	8	161	1.37	3% FDFM, low live FM 8 mph eyelevel winds
Krummholz	8	181	0.27	3% FDFM, 15 mph eyelevel winds
Ponderosa Pine Graminoid	2	101	0.61	6% FDFM, low live FM 5 mph eyelevel winds

Vegetation / cover type	Fuel Model 13	Fuel Model 40	Calculated cbh_meters	Conditions for transition to crownfire
SubAlpine Limber Pine	8	181	0.46	2% FDFM, 10 mph eyelevel winds
Ponderosa Pine Graminoid	9	121	2.01	6% FDFM, low live FM 5 mph eyelevel winds
Rock (Alpine-Upper Subalpine)	99	99	0	Not Applicable
Herbaceous Wetland Cross Zone - Wetland	1	103	0	Not Applicable
Shrub Upland Alpine	8	141	0	Not Applicable
Shrub Upland Lower Montane - Big Sagebrush	5	121	0	Not Applicable
Shrub Riparian Cross Zone > 9600 ft	5	122	0	Not Applicable
Shrub Riparian Cross Zone < 9600 ft	5	122	0	Not Applicable
Mixed Conifer with Aspen (Douglas-fir)	8	161	0.80	4% FDFM, low live FM 5 mph eyelevel winds
Unvegetated Surface	99	99	0	Not Applicable
Upper Montane Aspen	8	161	2.84	Not expected to torch
Natural Lakes, ponds, streams, rivers	98	98	0	Not Applicable
Reservoirs - Stock tanks	98	98	0	Not Applicable
Mixed Conifer with Aspen (Lodgepole Pine)	8	184	0.46	4% FDFM, 5 mph eyelevel winds
Blue Spruce	8	161	0.80	4% FDFM, low live FM 5 mph eyelevel winds
Mixed Conifer with Aspen (Ponderosa Pine)	2	121	2.16	4% FDFM, low live FM 5 mph eyelevel winds
Herbaceous Wetland Cross Zone - Wetland	1	102	0	Not Applicable
Mixed Conifer with Aspen (Spruce - Fir)	8	161	0.80	4% FDFM, low live FM 5 mph eyelevel winds
Lodgepole Pine - Rock	8	181	0.46	2% FDFM, 10 mph eyelevel winds
Riparian Upper Montane Mixed Conifer > 8500 ft	10	165	7.62	3% FDFM, low live FM 8 mph eyelevel winds
Riparian Lower Montane Mixed Conifer < 8500 ft	8	161	1.37	3% FDFM, low live FM 8 mph eyelevel winds
Riparian Aspen	8	161	4.27	Not expected to torch
Mixed Conifer with Aspen (Ponderosa Pine)	8	161	0.80	4% FDFM, low live FM 5 mph eyelevel winds
Juniper	2	121	2.61	2% FDFM, low live FM 8 mph eyelevel winds
Disturbance - Dead and Down (Ouzel area)	10	165	3.91	3% FDFM, low live FM 3 mph eyelevel winds
Disturbance - Dead and Down	99	99	0	Not Applicable
Glacier	99	92	0	Not Applicable
Disturbance - Dead and Down (Ouzel area)	8	161	0.61	3% FDFM, low live FM 3 mph eyelevel winds
Lodgepole Pine - High Elevation > 9500 ft	8	187	1.31	2% FDFM, 7 mph eyelevel winds
Mixed Conifer with Aspen (Spruce - Fir)	8	161	0.80	4% FDFM, low live FM 5 mph eyelevel winds
Juniper	8	161	0.76	2% FDFM, low live FM 5 mph eyelevel winds
Ponderosa Pine Rockland	9	186	1.49	5% FDFM, 7 mph eyelevel winds
Lodgepole Pine - Rock	8	183	0.81	2% FDFM, 10 mph eyelevel winds
Ribbon forests Islands	8	181	0.21	2% FDFM, 8 mph eyelevel winds
Herbaceous Wetland Cross Zone - Marsh	98	98	0	Not Applicable
Cottonwood	8	161	4.27	Not expected to torch
Juniper	8	181	0.21	2% FDFM, 5 mph eyelevel winds
Grass and grass-shrub (including open Ponderosa) vegetation within the Elk Winter Range	8	101 & 121		

FDFM = Fine Dead Fuel Moisture

Additionally, alterations in fuels since autumn of 2001(as a result of manual fuel treatments) were discussed. Fuel characteristics were then modified to reflect these changes using *RMP_fuels_work_v8.shp* provided by Emily Gubler. See Table 2. Both the modifications made to the Elk Winter Range and updates to fuels to reflect manual treatment areas were completed using FARSITE's landscape calculator.

Table 2. Fuels Characteristic changes following Fuels Treatments

Mechanical Treatment s	**Change in surface fuel model**	**Canopy cover change**	**Post-treatment CBH**
	-		
All treatment areas	TU5 changed to TU1 TL4 changed to TU1		CBH increased to 2.5meters (except Emerald area)
Emerald Mtn Treatment areas	TU5 changed to TU1 TL4 changed to TU1	Canopy cover reduced by 24%	Canopy base heights increased to 6.1 meters

CANOPY COVER (percent canopy cover): Density (class) was an attribute of the vegetation coverage (see metadata). Because a canopy cover value is only needed for tree species, the densities for all other species was changed to zero. The density classes were different than what is required for FARSITE, therefore these were changed to match that requirement. The midpoint of each class was then used to derive percent canopy cover.

STAND HEIGHT (meters X 10): Stand height (class) was an attribute of the vegetation coverage (see metadata). Because this height value is only needed for tree species, the heights for all other species were changed to zero. The upper value of each class was used.

CANOPY BASE HEIGHT (meters X 10): CBH_calc was used to determine and assign the CBH that would allow transition-to-crownfire in FARSITE, as described in FUELS section above.

CANOPY BULK DENSITY (kg / m3 X 100): Canopy bulk density (**CBD)** was calculated with Forest Vegetation Simulator – Fire Fuels Extension using fuels plot data (tree lists).

GIS Process:

The attributes (vegetation type, density and height) needed to create fuel layers from the *ROMOVEG.shp* shapefile were converted to rasters using ArcView's Spatial Analyst extension to match the extent of the ROMOCLIP_DEM. In addition, a grid was created to delineate east and west of the continental divide. Using the Grid Analyst | Transform Grid extension (available on ESRI.com) these grids were then combined, creating a combination grid of fuel types. New attribute fields (FuelModel_13, FuelModel_40, FuelModel_40_custom, StndHt_mX10, Cbh_mX10, and Cbd_KgM3x100) were created and populated as described above. Using ArcGIS, the fields were then each converted to rasters, then ascii files and a FARSITE landscape was generated using the standard process as described in the FARSITE Help Menu. Updates to fuels within the Elk Winter Range and fuel treatment areas (described above) were completed in FARSITE's Landscape Calculator (see FARSITE's Help Menu).

The units (LANDFIRE data compatible) used for each FARSITE fuel theme are as follows:

Field Name	Fuels Element	Unit used
Fuelmodel_40	Fuel Model	ScottBurgan models (40)
Cancov_pct	Canopy Cover	Percent
StndHt_mX10	Stand Height	Meters * 10
Cbh_mX10	Canopy Base Height	Meters * 10
Cbd_KgM3x100	Canopy Bulk Density	Kg/m^3 * 100

Landscape Development process – LANDFIRE data compatible:

Fuel layers (fuel model, canopy cover, stand height, canopy base height and canopy bulk density) were developed as described above.

ROMO_ELEV in meters:

A DEM for the entire park was obtained from the ROMO GIS Program. This was then clipped to a shape covering beyond the Rocky Mountain National Park boundary to include the extent of the vegetation coverage.

ROMO_SLOPE (in degrees) and ROMO_ASPECT (in degrees) were both derived from the ROMO_elev using Spatial Analyst.

The above mentioned grids were exported as ASCII files and then the ***ROMO_2006_40FM.LCP*** (FARSITE Landscape File) was created using the standard process as outlined in the FARSITE help menu.

**** NOTE ****

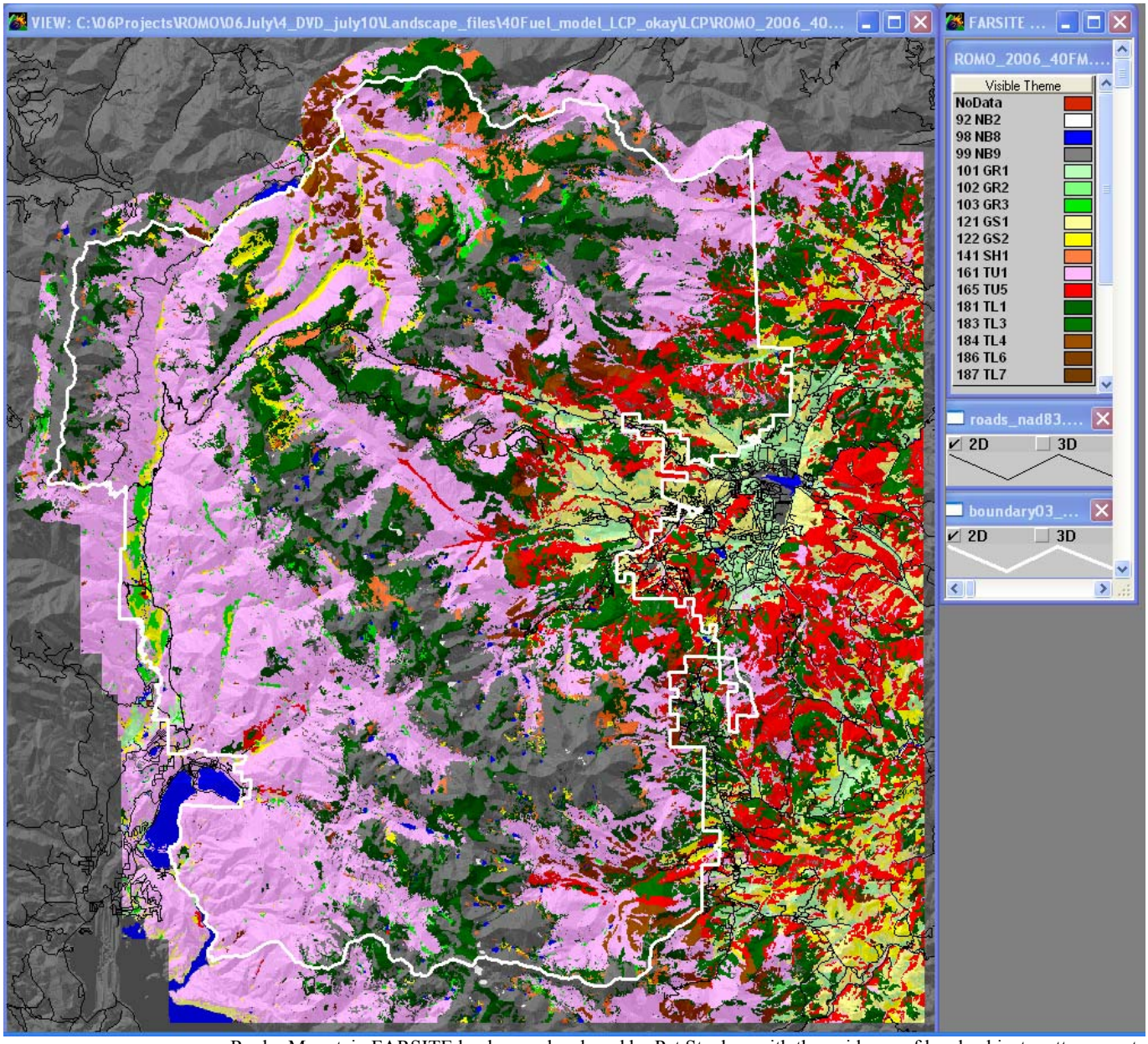
- When doing fire behavior calculations and/or simulations using the new dynamic fuel models (grass, GR 1- 9; grass-shrub, GS 1- 4; shrub SH 1 and 9; timber-understory, TU 1 and 3) it is crucial to use the appropriate live herbaceous fuel moistures. (see ScottBurgan2005-GTR-153.pdf pages 6-7).

- When using this landscape for FARSITE projections, DO NOT Link Crown Density and Cover, leave it unchecked!

- These fuel layers are meant to represent conditions as of March 2006. Following alterations of fuels from fire, fuel treatments, floods, avalanches, etc. updates to the fuel layers should be considered.

- If wind files are developed using RAWS observations (10 minute average winds) and no wind gust data is available, it will probably be necessary to double the windspeeds to adequately model crown fire behavior in FARSITE.

- **ADVANCED users should consider using the *ROMO_2006_custom_40FM.LCP* landscape instead of this one to take full advantage of the dynamic fuel models.**



Rocky Mountain FARSITE landscape developed by Pat Stephen with the guidance of local subject matter experts
July 2006

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